periods of heavy precipitation and over lands dipping steeply to the stream bed. The influence of the sharp, sudden thunderstorms of summer is immediately apparent in the neighboring streams, the surface, like all clays, shedding water freely when it becomes wet.

This region is subject to heavy thunderstorms and also large monthly amounts of precipitation during spring and fall, and in considering its outflow as aiding to produce freshet water in the James, it is important not to lose sight of these facts.

Primarily, of course, the amount of precipitation deposited must be the main point as a basis for calculation. But previous or attendant circumstances, or features, should also receive their proper share of attention, as, for example: prior condition of the soil in respect to dryness or moisture, its ability to absorb or shed moisture, depth to subsoil, character of subsoil, and *rate* of precipitation. These Appalachian and valley counties may be called the upper drainage basin of the James.

Proceeding to the watershed of the Piedmont and middle counties, we find the land rolling and very hilly, particularly on the lower slopes of the Blue Ridge, and falling gradually eastward to the tidewater division. The crest of the Blue Ridge is, geologically, the oldest land in the State, being the first to appear above the waters, and in its higher valleys originate most of the various streams which unite to drain this portion of the basin. In the Piedmont and parts of the middle counties basin is found a soil commonly known as "the red lands." Generally, the soil is fertile, and the exposed decomposing rock, in many localities, furnishes fertilizing ingredients, such as soda and lime, which, carried into the streams by washing rains, is deposited in the "bottom" lands, making them exceptionally rich and productive.

In 1607, Captain John Smith, speaking of tidewater Virginia, said: "The vesture of the earth in most places doth manifestly prove the soyle to be lusty and very rich." Had he applied this observation to these bottom lands, it would have been equally appropriate.

The area comprised in this portion of the James watershed is larger than that of either the valley or Appalachian, and, owing to the rolling character of the country, an excess of moisture does not require much time to reach an outlet. The soil is mostly lighter and more porous than that of the valley basin.

The main feeder of the James is the Rivanna River, which drains a region of large annual precipitation; it is subject to sudden rises to freshet height, which, entering the James at Columbia, make high water at Richmond generally within twelve hours.

This is usually a late spring, summer, or early fall condition, when thunderstorms are prevalent, and rises from this source, both large and small, may be easily traced on the hydrograph. A combination, with rises, coming down from the upper watershed, will produce the highest gage reading recorded at the Richmond station.

It constitutes a source of immediate and pressing danger to the business interests of Richmond, whenever sufficient precipitation occurs over its basin to cause 15 or more feet at Columbia, while for 19 feet flood warnings are issued.

Among the many features of interest connected with high water in the James, may be mentioned one which has an important bearing in estimating flood heights on the lower courses of the stream, viz, the flattening of the crest. From careful examination of the gage records at Lynchburg and Richmond, it is found that rises resulting from precipitation over the upper watershed (Appalachian and valley basins) will diminish in height from 1 to 2 feet on stages of 5 feet or less, and from 2 to 3 feet on stages between 5 and 12 feet. For the middle watershed (Piedmont and middle counties basin) flood water coming out of the Rivanna River shows, in a still more marked degree, this crest flattening. No daily gage readings for Columbia are available, so that the difference on moderate stages can not be determined; but for flood stages sufficient data are at hand to accurately estimate it. Comparison of Columbia stages of 19 feet, or more, with Richmond readings of the same flood wave, show a diminution in the vertical height of from 9 to 12 feet. But the Columbia gage readings are, in a sense, abnormal, and strictly local, and by no means indicate the general height of the river. The Rivanna here enters the James at nearly right angles, and at a point where the latter river is narrow, and it results, therefore, that freshet water coming from this source is banked up against the south shore of the James, producing a congested condition, during which it attains a local height greatly in excess of that at points either above or below, before it is carried away. Therefore, much of the flattening of flood crests between Columbia and Richmond may be ascribed to this cause.

In what are generally known as "Rivanna freshets," from 50 to 60 per cent of the height at Columbia will reach Richmond. Combined with flood water from the upper basin, the percentage increases from 60 to sometimes as high as 70.

The rate of flood travel is another highly important consideration. It varies with the amount of precipitation and watershed over which it is deposited. For that portion of the river above, or west of, Lynchburg, the information available is too meager to enable a satisfactory result to be arrived at, but from Lynchburg east to Richmond, the Weather Bureau readings will serve to show the time required for flood travel between the two points.

The river chart for 1898, represents, practically, an average year of water fluctuation and travel. It differs little in extremes or midstages from other years, not exceptional, and may therefore be used to determine the daily march, or progress, of a curve of high water. Summarizing the various rises shown thereon, it is found that upper river water will require from two to three days to pass from Lynchburg to tidewater, the difference in time depending on the volume carried; if accelerated by an influx from the Rivanna and other middle basin feeders, one and a half days are required.

Rivanna basin water, from Columbia to Richmond, moves down in from twelve to eighteen hours, the latter time being for moderate stages.

In the foregoing, the term "upper watershed" has been considered as applying to the Appalachian and valley counties drainage area, and "upper waters" as that portion of the stream contained in this watershed, while the middle watershed refers to the basin lying between the Blue Ridge and head of tide. Rivanna water belongs to this district, but is used distinctively on account of its preponderating influence in producing floods.

RECORDS BY THE KITE CORPS AT BAYONNE, N. J.

By H. L. ALLEN, Bayonne, N. J. (dated July 28, 1899).

The following table, showing the results of thermometer observations at Bayonne, is in continuation of that published on page 11 of the MONTHLY WEATHER REVIEW for January, and is communicated by Mr. Henry L. Allen, on behalf of his colleagues of the Bayonne kite corps. The star in the fifth column indicates those cases in which piano wire was used. As nothing is said to the contrary, it is to be assumed that the temperatures at or just below the kite are as recorded by a Six thermometer and that the maximum temperatures, therefore, in general, refer to some layer of air near the ground, while the minimum temperatures refer to the highest altitude attained. The records for New York City refer to the Weather Bureau station, whose thermometer is 313 feet above the ground and 350 feet above sea level, and have been supplied by the Records Division from the self-registers kept at the New York station.

Thermometer ascensions made at Bergen Point, Bayonne, N. J., by the Bayonne kite corps.

Number.	Ascension. Date.	Ascension. P. M. Began.	Ascension. P. M. Ended.	Kite record. Altitude.	Kite record. Temperature. Max.	Kite record. Temperature. Min.	Local conditions. Temperature. Beginning.	Local conditions. Temperature. Ending.	Local conditions. Wind.	Local conditions. Sky.	New York. Temperature. Beginning.	New York. Temperature. Ending.	New York. Winds during ascensions. Direction.	New York. Winds during ascensions. Velocity.	Average daily temperature observed by Mr. Eadie, at Bayonne, N. J. Same day.	Second day.	Third day.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
		H. M.	H. M.	Feet.	°	°	°	°			°	°		Miles.	°	°	°
61	February 7, 1899	8 40	9 40	400	23	22	23	22	nne.	Cloudy.	28	28	ne.	20	24.5	25.5	11
62	February 11, 1899	9 50	10 10	200	12	8	12	12	nw.	Cloudy and snowing.	8	8	nw.	12	6	8	9
63	February 13, 1899	3 00	3 30	100	10	6	10	10	nnw.	Cloudy; snowstorm.	4	4	ne.	38	9	17.5	16
64	February 22, 1899	2 10	3 45	942*	56	49	56	56	sw.	Partly cloudy.	47	49	w.	9	43.5	40	33.5
65	February 27, 1899	9 15	10 15	....	36	31	34	31	w.	Clear; moonlight.	40	40	nw.	26	42.5	36	40
66	March 25, 1899	8 15	9 35	753	32	30	32	32	se.	Cloudy; snowing.	31	31	se.	20	34	39	36.5
67	April 17, 1899	7 20	7 45	300	52	48	51	50	wsw.	Clear.	59	58	n.	19	49.5	50.5	52.5
68	April 22, 1899	4 35	5 22	400	57	52	56	53	s.	Clear.	55	52	se.	13	48.5	59.5	57.5
69	April 22, 1899	9 05	9 17	300*	45	43	44	44	sw.	Clear.	48	47	s.	10	48.5	59.5	57.5
70	April 22, 1899	9 35	10 45	525*	48	43	44	43	sw.	Clear.	47	46	sw.	10	48.5	59.5	57.5
71	April 25, 1899	8 12	9 50	750*	66	61	64	61	ssw.	Partly cloudy.	64	63	sw.	18	58	68.5	59.5
72	April 29, 1899	5 21	9 02	600*	66	58	66	58	sw.	Clear.	58	56	se.	14	57	65	72
73	April 29, 1899	9 32	10 00	300*	56	54	56	56	sw.	Clear.	56	56	s.	12	57	65	72
74	May 6, 1899	5 32	5 55	250	62	60	61	61	ssw.	Partly cloudy.	58	59	se.	8	59	64	59
75	May 6, 1899	8 27	10 26	2,100*	61	56	60	59	ssw.	Cloudy.	61	59	sw.	13	59	64	59
76	May 20, 1899	9 42	10 45	500*	54	50	54	50	nw.	Partly cloudy.	54	53	nw.	24	55.5	58	58.5
77	May 30, 1899	10 17†	12 03	715*	79	70	78	82	w.	Partly cloudy.	72	76	w.	12	70	74.5	76.5
78	May 30, 1899	8 50	5 30	1,667*	85	73	84	80	wsw.	Partly cloudy.	79	79	nw.	20	70	74.5	76.5
	May 30, 1899	...	...	500*	84	77	84	80	wsw.	Partly cloudy.	....	....	....	....	70	74.5	76.5
79	June 3, 1899	8 37	10 45	1,605*	70	66	70	66	sw.	P. cloudy to clear.	71	68	s.	7	74.5	71.5	79
80	June 8, 1899	8 42	9 37	400	82	76	82	76	w.	Clear.	82	81	n.	14	78.5	75	68.5
81	June 12, 1899	9 32	10 17	410*	68	66	67	66	sw.	Clear.	67	66	se.	11	68	71.5	80.5
82	June 19, 1899	8 47	9 30	481	75	72	75	70	wsw.	Partly cloudy.	75	75	sw.	7	73	80.5	75
83	June 23, 1899	8 50	9 26	400	72	66	72	69	sw.	Partly cloudy.	66	66	s.	12	68	79.5	74
84	June 24, 1899	4 05	4 53	568*	92	80	92	84	sw.	Partly cloudy.	82	79	se.	8	79.5	74	75
85	June 24, 1899	8 55	9 34	325	72	68	72	69	ne.	Cloudy and shower.	72	71	ne.	12	79.5	74	75
86	June 27, 1899	8 21	9 02	600*	72	70	70	70	ssw.	Partly cloudy.	72	71	s.	20	73	73	71
87	June 29, 1899	8 20	9 35	1,480*	70	65	70	64	nw.	Clear.	71	69	nw.	21	71	69	68.5
88	July 1, 1899	8 50	9 18	600*	68	66	68	66	s.	Clear.	....	....	....	....	68.5	75	79.5
89	July 4, 1899	11 05†	12 00‡	400*	91	84	91	91	s. to sw.	Partly cloudy.	....	....	....	....	78.5	78	78
90	July 4, 1899	1 55	5 00	2,400*	90	80	90	88	se. to s.	Partly cloudy.	....	....	....	....	78.5	78	78

*Piano wire used. †A. M. ‡Meridian.

MEXICAN CLIMATOLOGICAL DATA.

Through the kind cooperation of the Central Meteorologico-Magnetic Observatory, the monthly summaries of Mexican data are now communicated in manuscript, in advance of their publication in the *Boletin Mensual*. An abstract, translated into English measures, is here given, in continuation of the similar tables published in the MONTHLY WEATHER REVIEW since 1896. The barometric means have not been reduced to standard gravity, but this correction will be given at some future date when the pressures are published on our Chart IV.

Mexican data for June, 1899.

Stations.	Altitude.	Mean barometer.	Temperature. Max.	Temperature. Min.	Temperature. Mean.	Relative humidity.	Precipitation.	Prevailing direction. Wind.	Prevailing direction. Cloud.
	Feet.	Inch.	°F.	°F.	°F.	%	Inch.		
Aguascalientes	6,106	23.87	84.6	50.9	71.4	58	7.43	se.	ese., s.
Colima	1,600	28.27	95.7	64.8	77.2	80	15.23	wsw.	ene., sw.
Culiacán Rosales (E. d. S.)	112	29.70	98.6	63.5	85.8	55	......	sw.	ne.
Durango (Seminario)	6,243	24.04	89.6	51.8	72.3	52	2.13	sw.	e.
Leon (Guanajuato)	5,934	24.29	89.1	53.4	68.7	63	4.31	s.	ne.
Mexico (Obs. Cent.)	7,472	23.04	79.7	52.0	62.4	67	4.15	n.	ne.
Morelia (Seminario)	6,401	23.97	78.3	55.4	54.9	78	7.22	s., se.	ne.
Oaxaca	5,164	25.02	94.6	53.6	68.7	78	10.10	nw.	ne.
Puebla (Col. Cat.)	7,112	23.35	81.9	50.9	65.5	82	9.90	ene., e.	n.
Saltillo (Col. S. Juan)	5,399	25.01	95.2	56.8	71.1	70	6.50	n.	sw.
Tuxpan	19	30.14	104.9	66.2	82.0	78	9.49	e.	w.
Zapotlan (Seminario)	5,078	25.09	88.9	57.2	69.4	69	9.60	sse.	e.

THE PRECIPITATION OVER THE PACIFIC NORTHWEST AND THE POSSIBILITY OF HIGH WATER IN THE COLUMBIA FROM THE MELTING SNOW IN THE MOUNTAINS.

By B. S. PAGUE, Forecast Official.

The Columbia River, with its tributaries, drains that portion of the United States west of the one hundred and eleventh meridian and north of latitude 42°, except a portion of northwestern Washington and southwestern Oregon. The greater portion of the eastern half of British Columbia is also drained by the tributaries of the Columbia. The total area drained is approximately 350,000 square miles, or about 250,000,000 acres; an area nearly equal to one-half of that portion of the United States east of the Mississippi. The main tributaries of the Columbia are the Snake, Clark's Fork, Kootenai, Okanogan, Yakima, John Day, Deschutes, and Willamette. The Snake drains southern and eastern Idaho. It has two principal tributaries, the Clearwater, and the Salmon, the latter being much the larger. Western Montana, and northern Idaho are drained by the Kootenai and Clark's Fork. Eastern British Columbia is drained by lakes and streams all finally running into the Columbia. The Okanogon drains the northern portion of central Washington; the Yakima in Washington and the Deschutes in Oregon drain the eastern slope of the Cascades, and the John Day drains the southern slope of the Blue Mountains in northeastern Oregon. The Willamette drains the northwestern portion of Oregon between the Coast and Cascade mountains, north of the Calapooia Mountains. There are many other streams which are important tributaries to the Columbia, but for the purpose of this paper it is not necessary to mention them.

The country drained by the Columbia is, for the most part, mountainous, or high plateau. There are many valleys, all having elevations of over 1,000 feet, and the greater number having 2,000 feet and upward. The plateau country ranges in elevation from 1,800 to 5,000 feet. The mountains range in elevation from 2,500 to 12,000 feet. The line of perpetual snow, in the region under discussion, ranges from 6,000 to 8,000 feet. As few of the mountains have any considerable area above the snow line, it is seen that the winter's snowfall is almost entirely melted each year and the water carried off by the Columbia.

For the six months, from May 1 of each year, the total precipitation averages about six inches over the country drained by the Columbia, hence it is seen the rainfall occurring after the snow begins to melt is too small in amount to be considered in this discussion.

The precipitation over the country drained by the Columbia from October to April amounts to from 8 to 16 inches, and is principally in the form of snow; it settles and packs